Streszczenie w języku angielskim

Multiple sclerosis (MS) is a chronic progressive demyelinating and inflammatory disease of the central nervous system. The disease usually occurs in young Caucasian women, but it can occur in people of any age.

This disease mainly leads to focal damage to the myelin sheaths of nerve fibers in the brain or spinal cord. The location of the demyelinating focus, in the most common form of relapsing-remitting MS, results in the appearance of specific neurological symptoms during an exacerbation of the disease, called an MS relapse.

Relapsing-remitting MS involves sudden neurological deterioration followed by gradual improvement.

As a result of the relapse, a clinically isolated syndrome (CIS) of symptoms develops within a few hours or days, which may include: retrobulbar optic neuritis, limb paresis, cerebellar syndrome, and sensory disturbances. After a few days or weeks, remission occurs, i.e. neurological deficits disappear (at the beginning of the disease - completely).

Other forms of MS: secondary progressive (occurs after several or several dozen years of relapsing-remitting form; in this form, after relapses of the disease, the effects of damage to the nervous system remain, which gradually becomes ineffective, leading to the patient's disability) and primary progressive form (in which from the beginning of the disease, there is a systematic deterioration of the clinical condition) occur much less frequently.

Brain atrophy, also occurring in the course of MS, leads to cognitive disorders, and the disease often results in mood disorders and chronic fatigue. Multiple sclerosis is a demyelinating and inflammatory disease with a complex, yet not fully understood cause. The most frequently considered type of descent is an autoimmune process in which the cells of the immune system become overactive. When the blood-cerebrospinal fluid barrier is broken, autoreactive lymphocytes can damage myelin in the central nervous system with the help of produced antibodies and pro-inflammatory cytokines. Damage to the central nervous system may also occur as a result of the neurodegenerative process, causing brain atrophy (3A).

Genetic and environmental factors play a role in the pathogenesis of MS, such as Epstein-Barr virus infection, vitamin D deficiency, nicotine addiction, and obesity, especially in childhood.

Currently, for about 3 decades, many therapies have been used to change the natural course of multiple sclerosis; we can effectively treat exacerbations (relapses) of the disease, but there is no causal treatment leading to the cure of this disease.

Full understanding of the pathogenesis of multiple sclerosis and quick diagnosis of the disease will enable control of this disease, which is one of the most common non- - traumatic causes of disability in young adults.

The work uses a panel of biosensors working with the SPRi matrix technique as a new method to detect multiple sclerosis based on the determination of selected potential biomarkers in patients' blood plasma. These were constitutive proteasome 20Sc, immunoproteasome 20Si, ubiquitin C-terminal hydrolase L1, cathepsin S, fibronectin, leptin, and neuropilin-1. For these biomarkers, with the exception of neuropilin-1, biosensors are known for their determination.

The diagnostic usefulness of selected potential biomarkers in the diagnosis of multiple sclerosis, the possibility of determining the stage of the disease, the dependence of their concentrations on the frequency of disease relapses and the mutual correlation of selected biomarkers were checked. From the panel of tested biosensors, two: immunoproteasome 20Si and cathepsin S provide 100% diagnostic efficiency in terms of detecting multiple sclerosis. Both biosensors are characterized by 100% specificity and 100% selectivity with a disease detection threshold (cut-off) of 10.076 μg/mL for the 20Si immunoproteasome and 5.166 ng/mL for cathepsin S. Another three biosensors: constitutive 20Sc proteasome, UCH-L1 and fibronectin is characterized by 100% or almost 100% specificity and selectivity, and the cut- - off for the constitutive 20Sc proteasome is 4.29 μg/mL, for UCH-L1 - 7.63 ng/mL and for fibronectin - 186 ng/mL. The leptin biosensor shows poorer diagnostic performance. None of the tested biosensors are effective in distinguishing the stage of multiple sclerosis.

As part of experimental research, a biosensor for the determination of neuropilin-1 was constructed and validated. To check the proper operation of the biosensor, the concentration of neuropilin-1 was determined in samples from patients with multiple sclerosis, both using the biosensor and the comparative ELISA method.

The obtained results were published in the following articles:

1. Ewelina Górska, Marzena Tylicka, Adam Hermanowicz, Ewa Matuszczak, Anna Sankiewicz, Ewa Gorodkiewicz, Justyna Hermanowicz, Elżbieta Karpińska, Katarzyna Socha, Jan Kochanowicz, Marta Jakoniuk, Joanna Kamińska, Evgenija Homšak & Olga Martyna Koper-Lenkiewicz," UCHL1, besides leptin and fibronectin, also could be a sensitive marker of the relapsing–remitting type of multiple sclerosis", Scientific Reports | (2023) 13:3423, https://doi.org/10.1038/s41598-023-30237-3,

2. Ewelina Górska, Marzena Tylicka, Joanna Kamińska, Adam Hermanowicz, Ewa Matuszczak, Łukasz Ołdak, Ewa Gorodkiewicz, Elżbieta Karpińska, Katarzyna Socha, Jan Kochanowicz, Marta Jakoniuk, Evgenija Homšak, 10, Olga Martyna Koper-Lenkiewicz "20S constitutive proteasome, 20S immunoproteasome, and cathepsin S are high-sensitivity and independent markers of immunological activity in relapsing-remitting type of multiple sclerosis", *Journal of Neurochemistry 2024,* 24 June 2024, https://doi.org/10.1111/jnc.16165